Module designation	**Mathematical Modelling** **Indonesian title:** *Pemodelan Matematika* **Course code:** 8420202004
Semester(s) in which the module is taught	Semester 5 (Third year)
Person responsible for the module	**Coordinator:** Dr. Dian Savitri, M.Si. **Teaching staff:** Novita Vindri Harini, M.Pd.
Language	Indonesian
Relation to curriculum	Elective
Teaching methods	Lectures, self-directed work, questions and answers, interactive discussion, and project-based learning with student presentations **Media and tools:** Slides, LCD projector, whiteboard, UNESA Learning Management System (LMS), Python (Google Colab), Microsoft Excel or Google Sheets, GeoGebra
Workload (incl. contact hours, self-study hours)	**(Estimated) total workload:** 2 CU × 170 minutes × 16 weeks = 5,440 minutes = 90.67 hours (≈ 3.18 ECTS) **Contact hours:** lectures, 2 × 50 minutes per week × 16 weeks = 26.67 hours (class hours per week: 340 minutes = 5.67 hours, including structured activities) **Private study including examination preparation:** structured assignments, 2 × 60 minutes per week × 16 weeks = 32.00 hours; independent study, 2 × 60 minutes per week × 16 weeks = 32.00 hours (total 64.00 hours)
Credit points	2 CU (3.18 ECTS) *1 CU = 170 minutes per week × 16 weeks = 45.3 hours; 1 ECTS = 28.48 hours (144 CU = 229 ECTS), so 1 CU = 1.59 ECTS (UNESA Rector's Decree No. 736/HK/KM/2023).*
Required and recommended prerequisites for joining the module	Ordinary Differential Equations and Operational Research
Module objectives/intended learning outcomes	**Programme learning outcomes (PLO) addressed:** • PLO-5: Apply the basic principles of mathematics to solve simple mathematical problems. • PLO-6: Demonstrate mathematical knowledge and insight. **Course learning outcomes (CLO): after completing this module, students are able to:** • CLO-1: Explain the paradigm of mathematical modelling and the modelling cycle, based on scientific methods and on quantitative and qualitative analysis of a problem (PLO 5) • CLO-2: Construct and analyse simple mathematical models, including linear programming models and models of motion in mechanics, and determine feasible solutions by analysing and simulating the behaviour of the solutions (PLO 5) • CLO-3: Construct and analyse models based on differential equations for population dynamics, such as growth, predator-prey interaction, and harvesting, and find their solutions numerically using technology (PLO 5, PLO 6) • CLO-4: Construct, analyse, and simulate models of health

<table>
<tr><td></td><td>phenomena, such as tuberculosis, tumour growth, and the spread of infectious diseases, and interpret the feasible and applicable solutions (PLO 5, PLO 6)
• CLO-5: Design alternative mathematics learning based on modelling tasks with technology, and compile the modelling projects into a well-structured written report (PLO 6)</td></tr>
<tr><td>Content</td><td>This course studies the basic concepts of mathematical modelling and trains students to build models from real problems, analyse them, and interpret the results with scientific arguments instead of unfounded assumptions. Topics are the modelling paradigm and cycle; simple models, including linear programming and models of motion in mechanics; models based on differential equations for population dynamics, including growth, predator-prey interaction, and harvesting; and models of health phenomena, including tuberculosis, tumour growth, and the spread of infectious diseases. Each model is analysed qualitatively and simulated numerically with technology, and each project ends with an alternative way of teaching the idea in school mathematics. Learning combines lectures, self-directed work, discussion, and a series of modelling projects that students present and compile into a report.</td></tr>
<tr><td>Examination forms</td><td>Final score is calculated from the weekly assessment scheme below (CLO/PLO addressed and weight of each assessment):
<table>
<tr><th>Week</th><th>CLO</th><th>PLO</th><th>Weight (%)</th></tr>
<tr><td>1</td><td>CLO-1</td><td>PLO-5</td><td>5</td></tr>
<tr><td>2</td><td>CLO-2</td><td>PLO-5</td><td>5</td></tr>
<tr><td>3</td><td>CLO-2</td><td>PLO-5</td><td>5</td></tr>
<tr><td>4</td><td>CLO-2</td><td>PLO-5</td><td>5</td></tr>
<tr><td>5</td><td>CLO-3</td><td>PLO-5, PLO-6</td><td>5</td></tr>
<tr><td>6</td><td>CLO-3</td><td>PLO-5, PLO-6</td><td>5</td></tr>
<tr><td>7</td><td>CLO-3</td><td>PLO-5, PLO-6</td><td>5</td></tr>
<tr><td>8</td><td>CLO-3</td><td>PLO-5, PLO-6</td><td>15</td></tr>
<tr><td>9</td><td>CLO-4</td><td>PLO-5, PLO-6</td><td>5</td></tr>
<tr><td>10</td><td>CLO-4</td><td>PLO-5, PLO-6</td><td>5</td></tr>
<tr><td>11</td><td>CLO-4</td><td>PLO-5, PLO-6</td><td>5</td></tr>
<tr><td>12</td><td>CLO-4</td><td>PLO-5, PLO-6</td><td>5</td></tr>
<tr><td>13</td><td>CLO-4</td><td>PLO-5, PLO-6</td><td>5</td></tr>
<tr><td>14</td><td>CLO-5</td><td>PLO-6</td><td>5</td></tr>
<tr><td>15</td><td>CLO-5</td><td>PLO-6</td><td>5</td></tr>
<tr><td>16</td><td>CLO-5</td><td>PLO-6</td><td>15</td></tr>
</table></td></tr>
<tr><td>Study and examination requirements</td><td>Students are considered competent and pass if the final score, calculated from weekly tasks, modelling projects, and participation (70%), the midterm formative examination (15%), and the final formative examination (15%), is at least 55 or C.
Final index (grade conversion):
<table>
<tr><th>Index</th><th>Converted score</th><th>Score range (A = final score)</th></tr>
<tr><td>A</td><td>4.00</td><td>85 ≤ A ≤ 100</td></tr>
<tr><td>A-</td><td>3.75</td><td>80 ≤ A < 85</td></tr>
</table></td></tr>
</table>

	B+ | 3.50 | 75 ≤ A < 80 B | 3.00 | 70 ≤ A < 75 B- | 2.75 | 65 ≤ A < 70 C+ | 2.50 | 60 ≤ A < 65 C | 2.00 | 55 ≤ A < 60 D | 1.00 | 40 ≤ A < 55 E | 0.00 | 0 ≤ A < 40
Reading list	1. Aris, R. (1994). Mathematical modelling techniques. Dover Publications. 2. Barnes, B., & Fulford, G. R. (2009). Mathematical modelling with case studies: A differential equation approach using Maple and MATLAB (2nd ed.). CRC Press. 3. Edwards, D., & Hamson, M. (2016). Guide to mathematical modelling (3rd ed.). Macmillan International Higher Education. 4. Giordano, F. R., Fox, W. P., & Horton, S. B. (2014). A first course in mathematical modeling (5th ed.). Cengage Learning. 5. Murray, J. D. (2002). Mathematical biology I: An introduction (3rd ed.). Springer. 6. Brauer, F., Castillo-Chavez, C., & Feng, Z. (2019). Mathematical models in epidemiology. Springer. 7. Kapur, J. N. (1988). Mathematical modelling. New Age International. 8. Kelly, F. (2001). Mathematical modelling of the Internet. In B. Engquist & W. Schmid (Eds.), Mathematics unlimited: 2001 and beyond (pp. 685-702). Springer. 9. Blum, W., Galbraith, P. L., Henn, H.-W., & Niss, M. (Eds.). (2007). Modelling and applications in mathematics education: The 14th ICMI study. Springer. 10. Blum, W., & Borromeo Ferri, R. (2009). Mathematical modelling: Can it be taught and learned? Journal of Mathematical Modelling and Application, 1(1), 45-58.